Development of 8-Channel, 16-Bit Smart Card for Pressure Transducers

W.T. Powers/EB22
205–544–3452
E-mail: wt.powers@msfc.nasa.gov

The term “smart sensor” has been used in a number of different ways, ranging from sensors incorporating an active device to provide a more reliable interface to the sensor, to integrated sensors with a electronic circuit block including both digital and analog circuitry which becomes a “smart” periphery of a control system. However in the recent past, a broad definition has been achieved whereby a smart sensor is defined as one that is capable of:

- Providing a digital output;
- Communicating through a bidirectional digital bus;
- Being accessed through a specific address; and
- Executing commands and logical functions.

An 8-channel, 16-bit smart card for use in propulsion applications as shown in figure 101, has been designed, developed and fabricated to incorporate diagnostic and signal conditioning electronics. The three most important areas in the development of this 16-bit smart card are:

- Multiplexing of 8-channel inputs;
- Analog/ Digital conversion; and
- The processor which interprets decisions and implements those decisions.

The three main parts of smart DAQ board are shown in figure 102. This card has the following characteristics:

- Output is 16 bits;
- It has two data buses utilizing 485, each capable of addressing four sensors;
- It has fault detection capability to verify that the sensor is operational;
- It has an output code for sensor identification; and

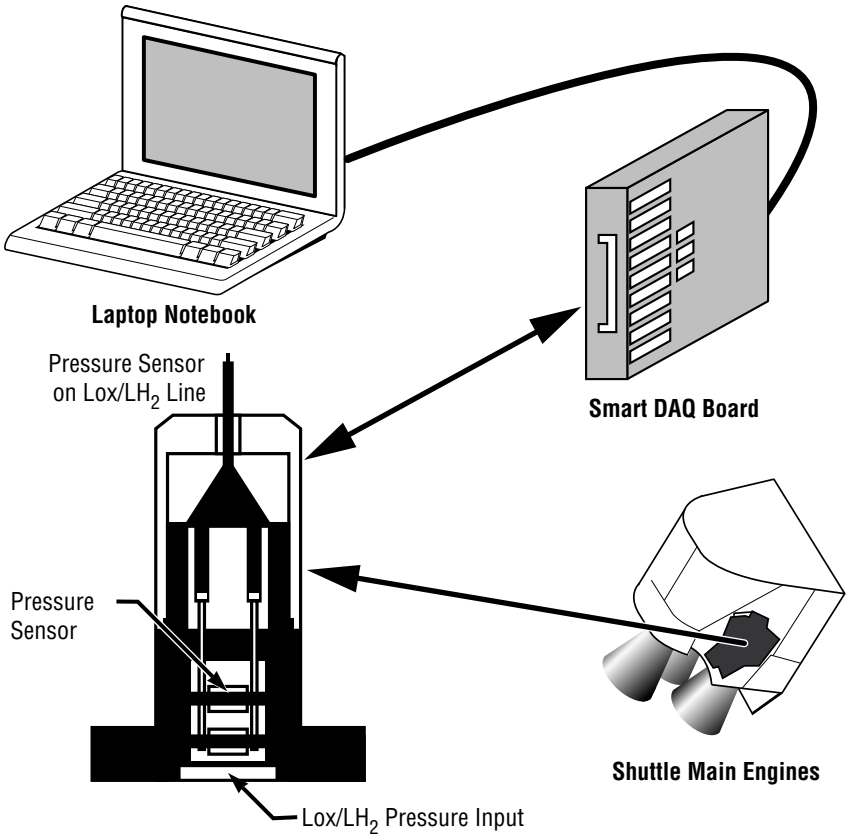

Figure 101.—Cryogenic smart sensor—system component diagram.

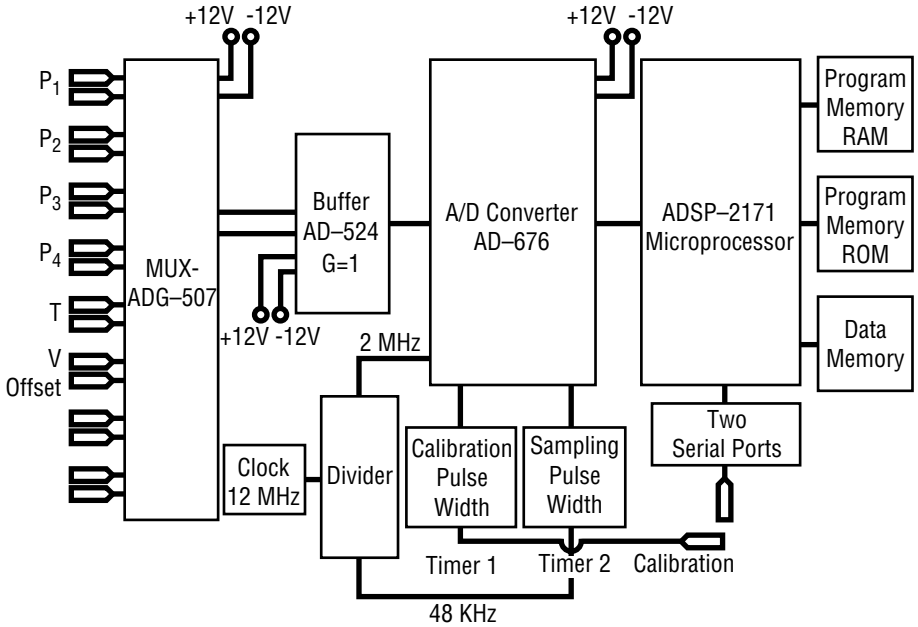

Figure 102.—Eight-channel, 16-bit smart card main functional components.

- It is capable of downloading calibration coefficients including zero, sensitivity, thermal, and other parameters required for conversion of sensor voltage output to engineering units, to a calibration table in the sensor process.

Reducing the number of leads is an important function for a majority of sensors. Data multiplexing as shown in figure 102 can not only reduce the amount of circuitry required for the sensor, but also reduces the number of external leads by multiplexing in sensing arrays and systems that require the simultaneous measurement of many signals in order to accurately measure the parameter of interest.

The second block (AD–676) provides digital output. Once the sensor data is digitized, a variety of signal processing schemes can be used to correct errors. These include offset cancellation, autocalibration, self testing, fault detection, correction and linearity correction. Another advantage is to perform some of these functions using a remote host processor rather than to implement them at the sensor site.

The third block of the smart DAQ card is ADSP–2171, a microprocessor which controls and manages the overall system. This processor interprets the information, makes appropriate decisions, and implements them.

Sponsor: RLV—Long-Term/High-Payoff Technologies Program

Biographical Sketch: W.T. Powers is a senior measurement systems engineer in the Instrumentation Branch of the Astrionics Laboratory of MSFC. He holds a bachelor of science degree in electrical engineering, and minors in mechanical, nuclear and physics from Tennessee Polytechnic Institute. He has 33 years of service with NASA and primarily deals with the development of advanced sensors and measurement, acquisition, and processing systems.